FOREST PEST MANAGEMENT

EFFECTS OF APPLICATION RATE AND TIMING OF ETHEPHON TREATMENTS ON ABSCISSION OF PONDEROSA PINE DWARF MISTLETOE 3 YEARS FOLLOWING TREATMENT

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Technical Report R2-52

October 1991

Renewable Resources
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ACKNOWLEDGEMENTS

The field assistance of E. Michael Sharon, Plant Pathologist, Lakewood Service Center, is greatly appreciated.

ABSTRACT

Evaluation of field tests of the plant growth regulator, ethephon, has shown that significant abscission of dwarf mistletoe shoots occurs within a few weeks after application. Tests conducted in the Black Forest north of Colorado Springs, Colorado in 1988 on ponderosa pine dwarf mistletoe showed abscission rates of 73 to 98 percent with mid-June, mid-July and mid-August applications of the chemical at rates of 2200 and 2700 ppm of ethephon in water with a spreader-sticker.

Examination of trees 3 years following treatment showed little development of immature shoots on all treatments and virtually no development of mature shoots with fruits on any infections, including controls (non-chemically treated trees). The lack of development of infections with shoots and fruits in the controls is attributed to a combination of natural control agents, including drought, branch mortality, and insects. Observations are planned to continue until mature shoots develop on both treated and non-treated trees.

INTRODUCTION

Several studies to evaluate the effectiveness of the plant growth regulator ethephon (2-chloroethylphosphonic acid) in causing the abscission of dwarf mistletoe shoots have been conducted in the past few years (see references). In the Rocky Mountain Region, tests on ponderosa pine dwarf mistletoe (Arceuthobium vaginatum) were begun in 1988. During June, July and August 1988, ethephon was applied by hydraulic sprayer at rates of 0 (control), 2200 and 2700 ppm with nonionic surfactant (Ortho X-77 spreader) in water to infected ponderosa pine in the Black Forest north of Colorado Springs, Colorado. Thirty non-systemic female infections were randomly selected in the lower crowns of pines for each treatment, usually three infections per tree. The numbers of shoots on each infection was determined and recorded prior to treatment and each year thereafter. Details of the study and subsequent yearly observations are contained in the reports by Johnson, Hildebrand and Hawksworth, 1989; and Johnson and Hildebrand, 1990.

This report summarizes data collected since the inception of the study in 1988.

METHODS AND MATERIALS

Direct observation of previously tagged infections on trees was made in July each year. The presence of shoots and those with fruits was recorded. Results for the two application rates were compared to the controls and to each other, and tested for statistical significance using the chi-square test.

RESULTS AND DISCUSSION

Data for each application date within treatments (June, July and August) were combined since there was little difference in results between treatment dates. Since seed dispersal commenced by early August, treatment by mid-July was effective in limiting spread of the disease in the first year. Loss of infected branches to mortality caused by breakage, girdling by rodents, and other natural agents was observed since the inception of the study and amounted to 30 percent (Table 1). An adjustment of the data base was made accordingly.

One month after treatment in 1988, frequency of infections with shoots was 94 percent in the controls, and significantly less in ethephon-treated infections. Frequencies ranged from 44 to 28 percent for infections treated with 2200 and 2700 ppm ethephon, respectively (Table 2). Results were significantly different between the two application rates 1 month after treatment. Only one infection had fruits out of 270 tagged for observation.

Table 1. Numbers of dwarf mistletoe infection sites remaining on live ponderosa pine branches treated with ethephon and observed over a 3-year period, Black Forest, Colorado.

Treatment	Year and Number of Live Branches Remaining			
	1988	1989	1990	1991
Control 0 ppm	90	81	71	61
Ethephon 2200 ppm	90	78	72	62
Ethephon 2700 ppm	90	81	72	66
Totals	270	240	215	189

Table 2. Percent changes in dwarf mistletoe infections with shoots and with fruits observed over a 3-year period on ponderosa pines treated with ethephon, Black Forest, Colorado.

Treatment	Year and Percent of Infections with Shoots and with Fruits							
	1988	1989		1990		1991	
	Shoots	Shoots	Fruits	Shoots	Fruits	Shoots	Fruits
Control 0 ppm	94.0	80.2	44.4	16.9	0	16.4	0
Ethephon 2200 ppm	44.4*	66.6*	6.4*	16.7ns	1.4ns	20.9ns	1.6ns
Ethephon 2700 ppm	27.8*	51.8*	1.2*	15.3ns	2.8ns	15.1ns	1.5ns

Treatment results compared with controls: * = $P < 0.05$; ns = not significant.

Development of small immature shoots was noted in all treatments by August of the first year. One year following treatment in 1989, frequency of infections with shoots was 80 percent in the controls, and significantly less for ethephon-treated infections: 52-67 percent. Frequency of infections with fruits was 44 percent in the controls and significantly less in ethephon-treated infections: 1-6 percent (Table 2). Results were not significantly different between the two ethephon application rates after the first year.

In 1989, natural abscission and insect activity caused the reduction in numbers of shoots observed in the controls. In 1990, 2 years after treatment, dwarf mistletoe shoot development was depressed uniformly over all treatments, apparently due to drought, and there was no significant difference in numbers of infections with shoots or with fruits for any treatment (Table 2). Out of a total of 215 infection sites observed, only 3 had mature shoots with fruits.

In 1991, we observed a continued loss of infections to natural causes in all treatments (Table 1) which has resulted in a 30 percent reduction in live infections since 1988. No differences in numbers of shoots or mature shoots with fruits were observed 3 years after treatment (Table 2).

Ethephon does not appear to provide long-term control of dwarf mistletoes but, by causing shoot abscission, it can substantially reduce the spread of the parasite. To our knowledge, ethephon has no systemic action and only external portions of dwarf mistletoe plants are affected. This data seems to support this. Regrowth of treated infections will eventually result in the production of mature shoots and fruits and subsequent spread of the parasite. Additional applications of ethephon will need to be made to protect mistletoe-free understory pines at some interval yet to be determined unless silvicultural treatments are used to remove infected trees. The most promising use of the chemical is in limited situations where high value infected trees need to be retained for aesthetic reasons and it is desirable to prevent infection of planted trees or natural regeneration of the same species.

We will continue to make yearly observations in this study until mature shoots with fruits are produced in the treatments. This data will serve to document the production of ponderosa pine dwarf mistletoe shoots following treatment with the chemical as well as losses to natural causes.

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